

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
11 March 2004 (11.03.2004)

PCT

(10) International Publication Number  
**WO 2004/020475 A1**

(51) International Patent Classification<sup>7</sup>: **C08C 19/44,**  
C08F 8/34

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(21) International Application Number:  
PCT/US2003/027081

(22) International Filing Date: 29 August 2003 (29.08.2003)

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(25) Filing Language: English

(81) Designated States (*national*): JP, US.

(26) Publication Language: English

(84) Designated States (*regional*): European patent (DE, FR,  
IT).

(30) Priority Data:  
60/453,693 30 August 2002 (30.08.2002) US

**Published:**

- with international search report
- with amended claims

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Date of publication of the amended claims: 15 April 2004

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*For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.*

(54) Title: FUNCTIONALIZED POLYMERS AND IMPROVED VULCANIZATES THEREFROM

(57) Abstract: A functionalized polymer defined by the formula  $\pi$ -R<sub>1</sub>- $\alpha$ , where  $\pi$  is a polymer chain, R<sub>1</sub> is a bond or a divalent organic group, and  $\alpha$  is a sulfur-containing heterocycle.

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## AMENDED CLAIMS

[received by the International Bureau on 03 January 2004 (03.01.04);  
original claims 1-2-6-7-8 amended; original claim 3 replaced by new claim 3;  
original claim 4 cancelled; remaining claims unchanged (3 pages)]

What is claimed is:

1. A functional polymer that is defined by the formula

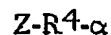


5 where  $\pi$  is a polymer chain,  $R^1$  is a bond or a divalent organic group, and  $\alpha$  is a sulfur-containing heterocycle selected from a thiirane, thietane, thiolane, thiazoline, dihydrothiophene, thiadiazine, thioxanthene, thianthrene, phenoxathiin, dihydroisothiazole, or thienofuran group or substituted form thereof.

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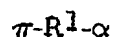
2. A method for preparing a functional polymer, the method comprising:  
terminating a living polymer chain with a functionalizing agent where the functionalizing agent is defined by the formula

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where Z is a leaving group or an addition group,  $R^4$  is a bond or a divalent organic group, and  $\alpha$  is a sulfur-containing heterocycle selected from a thiirane, thietane, thiolane, thiazoline, dihydrothiophene, thiadiazine, thioxanthene, thianthrene,  
20 phenoxathiin, dihydroisothiazole, or thienofuran group or substituted form thereof.

3. A method for preparing a cured tire component, the method comprising:  
providing a rubber formulation comprising at least one vulcanizable rubber  
25 and a filler, where the at least one vulcanizable rubber is a functional polymer that is defined by the formula



30 where  $\pi$  is a polymer chain,  $R^1$  is a bond or a divalent organic group, and  $\alpha$  is a sulfur-containing heterocycle selected from a thiirane, thietane, thiolane, thiazoline, dihydrothiophene, thiadiazine, thioxanthene, thianthrene,

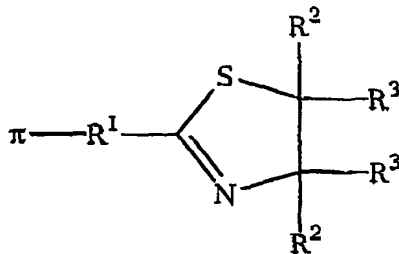
phenoxathiin, dihydroisothiazole, or thienofuran group or a substituted form thereof;

forming the rubber formulation into a green tire component;

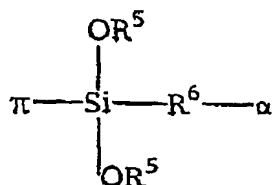
vulcanizing the green tire component to form a cured tire component.

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4. The polymer of claim 1, or the method of claim 3, where the functional polymer can be defined by the formula



where  $\pi$  is a polymer chain,  $R^1$  is a bond or a divalent organic group, each  $R^2$  is independently hydrogen or a monovalent organic group, each  $R^3$  is independently hydrogen or a monovalent organic group, or where each  $R^3$  combine with each other to form a divalent organic group; or where the functional polymer can be defined by the formula



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where  $\pi$  is a polymer chain, each  $R^5$  is independently a monovalent organic group,  $R^6$  is a bond or a divalent organic group, and  $\alpha$  is a sulfur-containing heterocycle.

20 5. The polymer of claim 1, or the method of claim 3, where  $R^1$  includes the residue of an addition reaction between an addition group and a living polymer, and wherein the addition group comprises a nitrile group, a Schiff base, a ketone group, an aldehyde group, or an ester group.

6. The polymer of claim 1, or the method of claim 2 or 3, where the polymer chain is a rubbery polymer having a Tg that is less than 0°C.
- 5 7. The polymer of claim 1, or the method of claim 2 or 3, where the polymer chain is polybutadiene, polyisoprene, poly(styrene-co-butadiene), poly(styrene-co-butadiene-co-isoprene), poly(isoprene-co-styrene), or poly(butadiene-co-isoprene).
- 10 8. The method of claim 2, where Z comprises a halide, a thio alkoxide group, an alkoxide group, a dialkyl amine group, a nitrile group, a Schiff base, a ketone group, an aldehyde group, or an ester group.
9. The method of claim 3, where the filler is carbon black, silica or both.

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 03/27081

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 C08C19/44 C08F8/34

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 C08C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 099 711 A (JSR CORP ; BRIDGESTONE CORP (JP)) 16 May 2001 (2001-05-16) abstract; claims; examples 1,2; table 1a page 6, line 40 - page 7, line 12 -----	1-10
X	DE 19 01 900 A (INTERNAT SYNTHETIC RUBBER COMP) 11 September 1969 (1969-09-11) claims; example 8 page 7, paragraph 2 - page 8, paragraph 2 -----	1,2,4,5, 7,9
X	EP 0 693 505 A (BRIDGESTONE CORP) 24 January 1996 (1996-01-24) abstract; claims page 4, line 1 - line 2 -----	1,3,4,6, 7,10
X	US 2 515 318 A (SCHOENE DWIGHT L) 18 July 1950 (1950-07-18) claims; examples -----	1,3-8,10
-/-		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*Z\* document member of the same patent family

Date of the actual completion of the international search

15 December 2003

Date of mailing of the international search report

29/12/2003

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PCT/US 03/27081

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>EP 0 295 675 A (BASF AG)  21 December 1988 (1988-12-21)  abstract; claims; examples  -----</p>	1-10

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Information on patent family members

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